CNS/ATM for Naval Aviation

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Purpose

This newsletter provides information to the Naval aviation community concerning requirements and developments in Communications, Navigation and Surveillance / Air Traffic Management (CNS/ATM).

In this newsletter, we continue our introduction of the changes taking place, and what is being done within Naval aviation to either implement the change or to work around the change. Please notify the editors of any developments that might be of interest to the Naval aviation community along these lines.

Relationship to GATM

The Air Force is also implementing CNS/ATM functions as part of a larger program. Recognizing their platforms lacked a Traffic Alert and Collision Avoidance System (TCAS) capability as well as Terrain Avoidance Warning System (TAWS), the Air Force combined those programs, CNS/ATM, JPALS, GPS modernization, and glass cockpit modernization under the umbrella of Global Air Traffic Management (GATM) as part of their Global Access Navigation and Safety (GANS) upgrades.

However, the Navy sensed that rapidly implementing TCAS and TAWS would result in improved safety, and chose to separate those programs from CNS/ATM. JPALS and GPS modernization were already separate programs. The scope of the Navy CNS/ATM program was deliberately limited to mirror civil aviation efforts.

COMMUNICATIONS

Digital Data Links

Although digital data links are not intended to completely replace voice communications, they offer some important advantages. For example, the pilot can receive a flight clearance digitally on a screen instead of having to listen to a voice transmission and copy it down using a pen or pencil.

The difference between voice and data link can be compared to the difference between the telephone and email. Voice communications are immediate, but subject to interpretation due to speech impediments, speaker volume, language proficiency, etc.. Often, the message needs repetition to achieve comprehension. Data link communications are faster, less subject to interpretation, recallable, and can be viewed by the pilot on the pilot's schedule. Data links expedite the delivery of graphic weather text, flight information service, and other information such as NOTAMS from the ground to the aircraft. Data links will also reduce congestion on voice channels, improve pilot understanding of instructions and information, reduce the need for the aircrew to manually copy transmissions, and facilitate collaborative decision-making between the controller and pilot.

As navigation accuracy increases and aircraft separation decreases, data link functionality becomes essential for safety. Due to the limited range of Very High Frequency (VHF) transmissions, VHF data links will be used over or near land, while High Frequency (HF) data links and satellite communications (SATCOM) data links will be used over water. The International Civil Aviation Organization (ICAO) has completed some initial tests and is progressing toward publishing a validated data link standard.

Aircraft (or originally, ARINC) Communications Addressing and Reporting System (ACARS) is an analog data link. In use since the mid-70's by commercial aviation, ACARS operates a byte-oriented VHF data link at 2.4 kilobits per second (kbps). With minimal effort, aircraft can provide reports such as the OOOI series (Out, Off, On and In), position reports, and engine data for example. The crew may receive, for example, V-speed data, weather reports, landing data requests, connecting gate information, and flight plan updates. There is no plan for ACARS to be mandatory in Naval aircraft.

VHF Data Link Mode 2, abbreviated VDL-2, was designed by ARINC as a digital system to replace the capacity strained ACARS. VDL-2 is a bit oriented CSMA (Carrier Sense Multiple Access) 25 kHz channel using phase shift keying for data. ARINC, a service provider, will provide VDL-2 starting in 1999 at the busiest US airports. VDL-2 increases the data rate to 31.5 kbps. Additionally, ARINC is establishing a network in Europe and throughout the world. In 2003, limited service in CONUS will be extended to high altitude en route sectors, evolving to high-density terminal areas. Like ACARS, there are no plans to make VDL Mode 2 mandatory in Naval aircraft.

It is anticipated that VHF frequency congestion will occur in the US as has occurred in Europe (see CNS/ATM for Naval Aviation, Volume1, Issue 1). For the long-term solution to the overall VHF frequency congestion problem, both the US and Europe endorse the use of Time Division, Multiple Access (TDMA) technologies. Two modes of VHF TDMA have been proposed, with demonstration projects ongoing. These are:

- **VHF Data Link Mode 3** (VDL-3)**:** A digital link that will be used for simultaneous transmission of voice and data on the same frequency.
- **VHF Data Link Mode 4** (VDL-4)**:** Used for data only. The proposed use is for surveillance.

The Federal Aviation Administration's next generation air-ground communications system (NEXCOM) will be an integrated voice and data system using the current 25 kHz channel spacing. NEXCOM incorporates VDL Mode 3 functions and has simultaneous voice and data capabilities, unlike VDL Modes 2 and 4, which are data only.

Initially, NEXCOM will be operated in analog mode (emulating current VHF radios), but in 2005 specific high altitude and high-density terminal sectors will transition to digital mode. Installation of ground based NEXCOM radios has been proposed to completed by 2010. At that time all high-altitude en route sectors and major terminal sectors will have transitioned to digital NEXCOM service. By 2015, all remaining Air Traffic Control sectors will transition to NEXCOM service. All civilian aircraft radios also will have transitioned. However, UHF will be maintained until the DOD can equip with NEXCOM capable radios. The Navy is currently considering incorporating a Mode 3 capability into the ARC-210.

VDL Mode 4 is being developed in Europe primarily as a surveillance system. By using a VHF frequency, VDL Mode 4 probably will have a greater range than Mode S (see CNS/ATM for Naval Aviation, Volume1, Issue 1), but the TDMA system will probably be less capable since it will be designed for surveillance only.

In the table below, the FAA's currently planned implementation schedule is provided. CPDLC refers to controller – pilot data link communications which will be discussed in a future news letter.

VHF Data Link Modes 2 and 3 Approximate Integration Schedule

Capability	Details	Altitude	When
Existing VHF Voice	Analog voice	>24,000 feet	Present - 2007
		<24,000 feet	Present - 2010
Mode 2, CPDLC 1	4 digital data messages	>24,000 feet	2002 - 2003
Mode 2, CPDLC 1A	18 digital data messages	>24,000 feet	2003 - 2004
Mode 2, CPDLC 2	118 digital data messages	>24,000 feet	2005 - 2008
Mode 3, Segment 1	TDMA digital voice only	>24,000 feet	2005 IOC, 2008 FOC
Mode 3, Segment 2	Adds TDMA digital data	>24,000 feet	2005 IOC, 2010 FOC?
Mode 3, Segment 3	TDMA voice and data	<24,000 feet	2010 IOC, 2015 FOC?

HF data links and SATCOM data links will be used for transoceanic communications. Depending upon where the aircraft operates, either HF or SATCOM or both will be required. When ICAO issues a validated data standard for transoceanic communications, we will study how to incorporate the functionality with the least impact to the platform.

With over 1500 lightweight AN/ARC-210s installed, the AN/ARC-210 program manager has initiated a study to upgrade the ARC-210 to capture civil VDL Mode 3 functions. With this modification, this military radio will be interoperable with the civil air traffic service providers throughout the world. Dual use avionics (that is, avionics capable of performing both military and civil functions) is a very cost-effective way to provide both civil and military functionality. If CPDLC eventually becomes a military requirement, software upgrades to the communication system's processor may capture this functionality.

CNS/ATM NEWS

C-9 Implementation Plans

Some platforms have implemented some of the CNS/ATM functionalities. Among them is the C-9. PMA 207 reports that C-9 has implemented all of the communication,

navigation, and Mode S requirements discussed in the last newsletter except for Required Vertical Separation Minima (RVSM). For implementing RVSM, they report "RVSM related barometric altimeter equipment upgrades and FAA certification are being accomplished this year by the C-9 IPT. Pitot-static system inspections and altimeter/autopilot dynamic altitude hold accuracy evaluations will be done for our 15 Navy Reserve and two AIRLANT Marine Corps C-9B aircraft. The Team Leader of 4.1 is the focal point of a NAVAIR-Lockheed-AeroMech-FAA team who will deliver our first RVSM certified C-9B by next Christmas, and finish them all in time for the Europe FL290-410 implementation date discussed in Volume 1, Issue 1."